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RESEARCH NOTE

A PRELIMINARY STUDY ON THE DIURNAL FORAGING ACTIVITY AND NUTRIENT PREFERENCES OF *Tetraponera rufonigra* (HYMENOPTERA: FORMICIDAE) IN PULAU PINANG, MALAYSIA

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Tetraponera rufonigra (locally known as "semut Selangor") is a large bi-colored ant species with a broad dark head and gaster and light orange-brown body. It is a monotypic species-group and is widely distributed around the Indian subcontinent as well as Southeast Asia as far south as Sumatra and Java (Davidson *et al.,* 2003). This ant is a potential health risk to the people around them. There was a case of anaphylaxis induced by *T. rufonigra* reported in Thailand (Wanotayan *et al.*, 2005). In Malaysia, a case was reported in Bukit Mertajam where a student was sent to Hospital and admitted to Intensive Care Unit (ICU) after being stung by *T. rufonigra*. The bite of *T. rufonigra* is very painful and sometimes causes considerable inflammation (Hirashima *et al*., 1979). Study on the behavior of this ant is sparse in Malaysia considering its importance lately. In this paper, we report the foraging behavior and nutrient preferences of *T. rufonigra*.

Studies were done around the Tapak Konvo, Minden Campus in Universiti Sains Malaysia, Pulau Pinang. Four trees nested by *T. rufonigra* were selected. Four grams of fresh tuna was placed in each of five dishes and used as baits. These petri dishes were placed randomly around the tree base and left for 72 hours. This experiment began at 1930 h and ended at 1930 h three days later. Digital images of the ants foraging on the petri dishes were taken every four hours using a digital camera (Nikon Coolpix S60). Temperature and humidity readings were also recorded. The number of target ants foraging on each petri dish was counted after the image was transferred into the computer. Coarse sugar, pure honey, peanut butter, fresh tuna and margarine were used as nutrient sources in this study. These baits represent respectively the carbohydrate, protein and lipid foods. Four grams of each type of food was placed into a petri dish measuring 90 mm in diameter. A replicate contains five dishes randomly placed on a cardboard (35.0cm x 4.5cm). Three trees which were heavily infested by *T. rufonigra* were selected for this study. Twelve replicates were conducted at each tree in 12 days, which made the total of 36 replicates. Temperature and humidity readings were recorded. The cardboard with the five food types were placed directly on the ant foraging trails for 30 minutes (1615 to 1645 h). After 30 minutes, digital images of the target ant present on the petri dishes were captured using a digital camera. Food preferences of *T. rufonigra* were determined by counting the number of target ants visiting the bait. For the nutrient preferences, results were analyzed using One-Way ANOVA and means were separated with Tukey's HSD (at $P = 0.05$) using SPSS V17.0.

Tetraponera rufonigra showed a distinct foraging pattern during this continuous 72 hours study. This ant was found to start their foraging activity at around between 0730 hour and 0930 hour and the number of foragers continued to increase gradually until it peaked at about 4 hours after the foraging activity had started. Foraging activity continued for about 12 hours (temperature 27-30ºC, RH 50-60%) and started to decrease in the afternoon around 1730 hour (temperature $\leq$ 27ºC, RH $\geq$ 60%).

From this study, it was found that this ant species is diurnal where they actively foraged during day time at about 30 minutes to 2½ h after sunrise (Figure 1). When the foraging activities of *T. rufonigra* became minimal, ant species such as *Crematogaster* sp., *Pheidole* sp*.,* and *Odontoponera*

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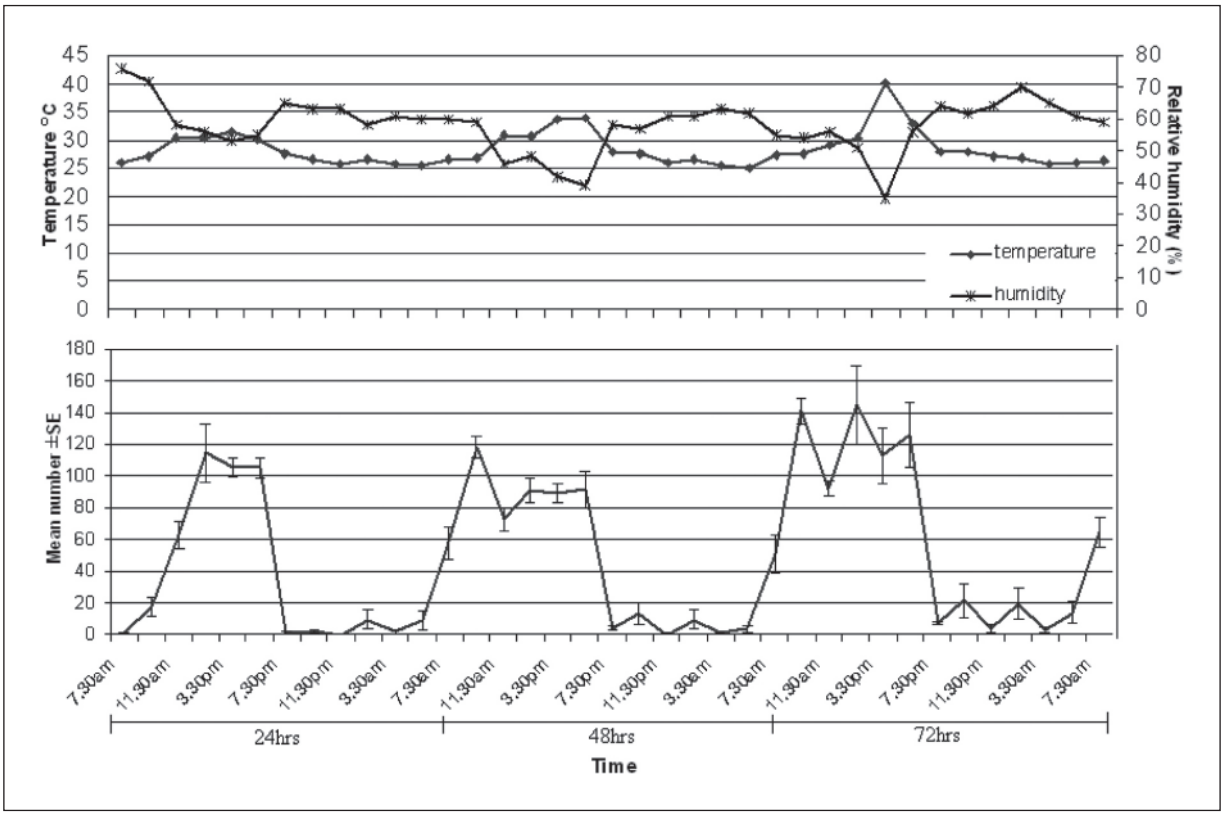

Fig. 1. Foraging pattern of *T. rufonigra* and mean temperature and relative humidity

sp. began to forage at the bait stations. Perhaps these three species are nocturnal (Lee, 2002) and are only active at night and also to avoid competition with the more aggressive ants such as *T. rufonigra*. Many studies revealed that different species of ants have their own unique foraging patterns. For example, *Monomorium pharaonis* and *Solenopsis geminata* are known to start foraging 2-4 hours after sunset and foraging time can last for about 12 hours (Norasmah *et al.,* 2006a; Lee, 2002) while foraging activity of *Tapinoma melanocephalum* depend on the seasons. They were found to be active during morning hours in the summer and skewed towards late afternoon hours during the winter season (Agarwal & Rastogi, 2009). Foraging activity may also correlate with the ambient temperature and relative humidity (Lee, 2002; Cole *et al.,* 2008). Some species of ants like *Pheidole spp.* can remain active at soil temperatures between 15- 35ºC (Walter *et al.*, 1981) and some ants such as the Argentine ant can tolerate temperatures as high as 30ºC, but when the ambient temperature is above 30ºC, the number of foraging ants will be reduced (Markin, 1970). The number of foragers at day 2 to day 3 was higher since there were a positive feedback by many workers that leave their pheromone trail from the food source to the nest as the food was offered at the sampling area *ad libitum*.

Table 1 shows the mean number of *T. rufonigra* foraging on five different food types representing three different nutrients i.e; protein, carbohydrate and lipid. It was found that *T. rufonigra* preferred protein food from tuna bait (33.11±2.57), followed by carbohydrate food viz. coarse sugar and honey; 23.80±2.82 and 19.31±1.32, respectively. Peanut butter and margarine were the least preferred food of the ants. There were a significance difference in the number of ants consuming the bait of different nutrients ($P<0.05$). However, no significant difference in the number of ants consumed sugar and honey baits indicates that both baits which contain carbohydrate are also accepted by this ant. Lipids, a source energy and food reserve was the least preferred food of the ants. Many studies were also

Table 1. Number of ants foraged at different types of food

Food Types	Mean number ± S.E.M
Fresh tuna	33.11 ± 2.57a
Coarse sugar	23.80 ± 2.82b
Honey	19.31 ± 1.32b
Peanut butter	7.61 ± 1.14c
Margarine	1.14 ± 0.26c

Mean number followed by the same letter shows no significant difference (One-way ANOVA, $P < 0.05$).

revealed that lipid foods were ignored by ants when they were allowed to choose their diet especially when there were abundant carbohydrate and proteinaceous foods (Chong, 2005; Norasmah *et al.,* 2006b; Lee, 2002).

Most ants feed on weak or scavenged prey (Davidson *et al.,* 2004) to get protein supply for a colony but hunting for preys can cost a lot of energy. Carbohydrate is relatively easy to collect from flower's nectar around the sampling area. Thus the ants will take full advantage upon finding ample amount of protein food at the sampling area. We speculated that they will remove as much protein foods as they can from the petri dish to store in their nest. We also found that this ant preferred tuna over peanut butter, suggesting that this ant might prefer animal protein compared to other sources of protein. We believe that the formation of the bait did not affect much on the number of food consumed since the chemical nature of food can also influence the recruitment decisions (Portha *et al.,* 2002). Previous studies revealed that some species of ants such as *S. geminata* and *S. xyloni* preferred proteinaceous food while structure-infesting ants such as tramp ants viz. *Monomorium* sp*., Tapinoma* sp*., Paratrechina* sp. were usually attracted to carbohydrate foods (Norasmah *et al.,* 2006b; Loke & Lee, 2006; Eow & Lee, 2007; Hooper and Rust, 1997). Both protein and carbohydrate are important if the number of brood in the colony was high. Brood needs protein for growth, and workers need carbohydrate for energy to care for the brood although the relocation of protein in the colony is not as fast as carbohydrate (Davidson *et al.,* 2003, Loke & Lee, 2006).

Our results have shown that the foraging pattern for many species of ants fluctuate overtime due to many factors such as human disturbance, temperature, relative humidity, rain, predators and food availability. If the food around the nest area is sparse, ants might have to forage in a longer time and in wider range. Perhaps the foraging pattern and time of *T. rufonigra* will also be different at different places due to the changes of biotic and abiotic factors.

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